The Adverse Consequences of Unnecessary Collocation

I. Introduction

This appendix describes in detail the adverse consequences from any requirement that an entrant install collocated facilities (or otherwise rely on a manual process) to access and combine network elements. Specifically, the appendix explains that collocation:

(1) imposes unnecessarily prolonged service interruptions for customers when they change to a CLEC as their local service provider;

(2) delays the CLEC's ability to enter the market via network element combinations;

(3) degrades the quality of the end user customer's service;

(4) imposes wasteful and unnecessary costs on CLECs; and

(5) severely restricts the rate at which CLECs could switch customers over to UNE-based service after the collocation arrangement is established.

As demonstrated below, imposing an unnecessary collocation requirement does not provide CLECs with nondiscriminatory and just and reasonable access to combine unbundled network elements. Before discussing the effects caused by unnecessary collocation, however, it is useful to begin with a brief description of the typical loop and local switching architectures used by ILECs today.

II. The Starting Point

There are two basic architectures used to connect loops to the local switch. The first, and most common, involves conventional copper loops and a Main Distribution Frame (MDF). In the second, more modern architecture, an Integrated Digital Loop Carrier (IDLC) system carrying numerous multiplexed digital loops bypasses the MDF and attaches directly to the switch.

A. The Conventional Copper Architecture

The typical configuration for attaching copper loops to switch ports uses the MDF, which consists of a series of connector blocks attached to ironwork uprights anchored to the floor and ceiling. On each side of the MDF is a series of connector blocks which typically contains 200 terminals at which individual wires can be connected. To aid frame technicians in distinguishing the two sides of the MDF, the connector blocks on the line side are arrayed vertically, and the connector blocks on the switch side are arrayed horizontally.

Copper loops are typically attached to switch ports in the following manner. First, cables carrying multiple loops enter the central office and run to the MDF. At the frame, each loop (typically a pair of copper wires) is segregated from these cables and connected (by being installed at the appropriate position on the block and then either wire wrapped or soldered) to the specific terminal on a connector block to which it is assigned. This "hard-wired" connection is installed at the time the cables are brought into the central office. Barring cable replacement, ILEC technicians never touch these connections.

A second wire, known as a "cross-connect" (sometimes called a "cross wire" or "jumper"), is then attached to those same line side terminals. The cross-connect runs to the other (switch) side of the MDF, where it is attached to a specific terminal on another connector block. From those terminals, a pair of wires runs to the switch port (also known as the "line card" or "line termination unit"). This final connection from the terminal to the line card is also a "hard-wired" connection that the switch vendor establishes when the switch is installed. Again, barring equipment failure or replacement, it is never moved or altered.

ILECs maintain a software data base inventory of the numbers assigned to each piece of equipment making up the loop-switch combination. They typically track each copper loop by its cable and pair number, and record its place on the connector block ("block assignment") by assigning a number to each terminal on each block. Similarly, the line units (on line ports) on the switch are assigned identifying numbers.

Although most copper loops are attached to the switch in this manner, some are not. For various reasons, it is sometimes preferable to introduce a second frame, called the Intermediate (or "Tie Pair") Distribution Frame (IDF), when connecting to the switch port.[1]

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[1] An IDF is used primarily to minimize the length of jumper wires traveling across and MDF, or to insert additional technologies between the loop and port (such as amplifiers or special services equipment). In all cases, the ILEC has control over whether or not to install an

In this configuration, the ILEC runs a cross-connect from a loop appearance on the MDF to a designated block which extends the loop over the IDF on a tie-cable. From there a second cross-connect is established on the IDF which extends the loop down to the CLEC's collocated facilities over a second tie cable. From the CLEC's collocated facilities a tie-cable extends the loop back to the IDF where a third cross-connect is run to a designated block which delivers the loop back to the MDF over yet another tie-cable. Finally, on the MDF a fourth cross-connect is run to connect the loop, via this very oblique route, to the switch.

B. The IDLC Architecture

Although the MDF-based architecture is the most commonly used today, ILECs are turning increasingly to the superior IDLC technology for serving new residential and commercial developments and, where appropriate, replacing old plant. Instead of aggregating copper loops in cables and carrying them all the way to the MDF at the central office, the ILEC first collects a number of loops at a remote IDLC terminal located in an underground vault or locked cabinet in a neighborhood. The remote terminal converts these analog loops to a digital signal and multiplexes all the digital signals onto a digital carrier system for transmission to the central office. At the central office, the digital loops bypass the MDF altogether and access the switch directly through a digital cross-connection frame. No analog signal or physical reappearance on an MDF is ever re-established to identify an individual subscriber's loop.[2]

III. Collocation Proposals to Combine Network Elements

A. Physical Collocation

Physical collocation is simply space within a central office that is leased by, and

intermediate frame and what equipment will be attached to that frame. In the collocation architectures described here, the CLEC has no choice regarding the use of intermediate frames -- they are used whenever the ILEC decides to use them.

[2] Therefore, when a customer is served by an IDLC loop, there is no wire at the MDF that is associated with that loop which can be disconnected for reconnection by a CLEC. Moreover, in some circumstances, there is no way to re-establish a copper pair loop for an individual subscriber that is served by IDLC so that the customer could be switched to a CLEC-assigned loop.

dedicated to, a CLEC. Such space is often located at a significant distance from the MDF -- possibly hundreds of feet and/or several floors away. Typically, such space is enclosed with a wire mesh cage, with entry through a locked door controlled (except in emergencies) by the CLEC. Within the cage, a CLEC that wanted to combine the loop and switching elements would need to install its own "mini-MDF," tie-cables to the ILEC's frame, and cross-connects.

Any form of collocation involves, at a minimum, the installation of a set of tie cables between the MDF and the CLEC's pre-wired frame.[3] Assuming that: (a) space is available, and (b) that the physical collocation node has already been constructed and is operational,[4] requiring collocation introduces an entire sequence of unnecessary *recurring* steps to provision service to each individual customer using the loop and switch network elements. The discussion below describes the steps needed to provide UNE-based service to the typical single-line customer who wishes to switch over to a CLEC, using assumptions designed to maximize efficiency.[5]

In the most efficient approach, the ILEC would pre-wire all of the cross-connections on the connector blocks at the IDF (if an IDF were used). This would effectively establish a connection from new connector blocks on the MDF, through the tie-cables to the IDF, through the CLEC's pre-wired cross-connection frame in the collocated space. From the CLEC's pre-wired frame, the connection would go back to the IDF and finally back to the MDF, where it originated. This pre-wire creates a giant "U" shaped circuit, with the new connector blocks on the ILEC MDF waiting to have loops and switch ports connected to them.

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[3] Or, in those ILEC offices which use IDFs, between the MDF and the IDF, and then between the IDF and the CLEC's pre-wired frame.

[4] There are a long list of issues concerning the initial establishment of collocated space that are not addressed here such as: space exhaust in some central offices, excessive non-recurring costs to condition space, planning horizons, construction intervals, etc....

[5] Some ILECs have added an additional unnecessary layer of complexity to this process by adopting a policy of assigning a new switch port to all CLEC customers who the CLEC wishes to serve with a loop/switch combination. This policy prevents CLECS from using the most effective approach of accomplishing a customer cutover using a collocation arrangement. There is simply no technical necessity for this policy. Indeed, given that the customer's service, phone number and features are already programmed into the switch on the existing switch port, assigning a new switch port only adds another level of complexity, confusion and potential for error into the cutover process for CLEC customers.

Next, the CLEC would submit a service order requesting the loop and switch network elements for a specific customer. The request would specify the tie-down information such as the tie-cable and pair number, and the block assignments to connect that particular customer to the pre-wired "U" circuit through the CLEC's collocated frame and back to the MDF.

Assuming the pre-wiring described above is in place, the ILEC then performs the actual cutover of service. The most efficient way to accomplish the cutover is by performing a "hot-cut" -- i.e., a coordinated cutover of the customer's service -- to minimize customer downtime. To perform this work, the ILEC frame technicians would lay-in new cross-connection wires from the customer's loop and switch location on the MDF to the CLEC's connector blocks. The frame technician would then remove the existing cross-connection from the loop to the switch port, causing the customer to lose service. The technician would then connect the new cross-connections that were just laid in, and remove the old, previously disconnected, wires from the frame.

But even all of this activity does not complete the customer cutover. In order to complete that process, the ILEC's central office frame technicians must coordinate their work with the ILEC Software Control Center, which is typically located at a different site. Finally, the ILEC must test continuity from the new switch port termination at the MDF to the original loop termination at the MDF.[6]

B. Virtual Collocation

In a typical virtual collocation, the above description for physical collocation changes in one notable respect. With virtual collocation, the ILEC has complete control over the collocated equipment and may perform the recombining of the elements on behalf of the CLEC. Even if a CLEC virtually collocates a pre-wired frame, however, the ILEC would still need to independently engineer the entire connection, make all of the block assignments, and so forth.

In other words, virtual collocation retains each of the manual steps which characterize the physical collocation scenario. The sole distinction concerns the final cross-connection between the loop and port which, in the virtual collocation environment, could

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[6] If continuity is not established, or if the incorrect switch port has been attached to the loop, then the ILEC and the CLEC must together troubleshoot the daisy chain of tie-pair cables and cross-connect wires until customer service is restored.

be performed by ILEC personnel.[7]

C. Other "Collocation" Proposals

In addition to the conventional collocation arrangements described above, various RBOCs have proposed alternative "collocation" arrangements that retain each of the manual processes identified above, but which house the CLEC's cross-connection activity in a non-traditional location. These alternatives generally fall into three categories: (a) proposals which may reduce the cost of collocation without reducing the need, (b) proposals which require the "remote collocation" of the CLEC's facilities, and (c) proposals which involve an ILEC-provided remote frame for CLEC cross-connection activity.

With respect to the first category of alternatives, these various collocation proposals -- i.e., "mini collocation," "shared collocation" and "cageless collocation" -- do little to improve the fundamental barriers created by mandatory collocation to combine network elements.[8] Allowing CLECs to use smaller, shared or less expensive collocation arrangements may partially reduce the congestion that makes physical collocation impractical in some central offices, but it does little or nothing to reduce the time needed to obtain physical collocation. Moreover, these proposals have no impact at all on the time needed to perform hot cuts and they would continue to burden entrants with unnecessary manual processes to serve each customer. Finally, these collocation alternatives do not reduce by one iota the service quality and customer outage problems -- or the competition gating effects -- of a mandatory collocation requirement that are described in detail below.

These problems also contaminate the second category of proposals which effectively move the CLEC's collocation facilities to a remote location. For example, SBC "offers" to extend the loop and port cross-connections to a remote location outside the central office for recombination. Such proposals, however, retain each of the manual processes cited above and actually increase the outage-risk and quality-degradation concerns that arise from needlessly increasing loop lengths. Further, while the CLEC's costs decline with the avoidance of collocation charges to the ILEC, these declines are offset by the costs associated with the remote location.

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[7] Bell Atlantic is even insisting that CLECs install a remotely-controlled, electromechanical "robot" to actually cross-connect the loop and local switching elements in the virtual collocation environment.

[8] In those instances where collocation is *desired* by the entrant, however, these proposals are a welcome improvement.

The final category of proposals similarly tries to conceal the basic problems associated with collocation by calling the collocation arrangement something different. These proposals include the Bell Atlantic "Assembly Room and Assembly Point" proposals and the U S WEST SPOT frame. The SPOT frame and Assembly Room are nothing more than a collocation frame shared by the CLECs which is installed by the ILEC in non-traditional, non-central office space (such as a basement, former janitor's closet, former office space, etc...).[9] Although these proposals are put forward as "alternatives", they all share the same problems of any collocation arrangement -- cost, delay and manual processes.

IV. The Anticompetitive Consequences of Manual Recombination and Collocation

Introducing manual processes and complex coordination obligations each time a single customer wants to change local service providers will severely restrict the number of customers that can change their local carrier. Moreover, designing processes with extensive and unnecessary activity and coordination only creates the likelihood for extensive human error and associated customer dissatisfaction, all of which will be focused on the CLEC's service.

Even under the best of circumstances, manual reconnection of the loop and switch via collocation through the manual processes described above is cumbersome and inefficient. In particular, the approach imposes four serious obstacles to effective competition:

(A) It requires that the CLEC customer's line be taken completely out of service and creates a substantial risk of an extended outage;

(B) It will prevent CLECs from using loop/switch combinations to: a) to serve any customers soon; b) to ever serve competitively significant numbers of customers; and c) to serve some customers (e.g., those on IDLC) at all;

(C) It will impose inferior service on CLEC customers compared to the service that ILEC customers receive; and

(D) It will impose excessive and entirely unnecessary costs that could, by themselves, effectively foreclose competition via loop/switch combinations.

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9 The Assembly Point is a collocation arrangement which is located on the exterior walls of the central office building.

Collectively, the obstacles mean that any manual process -- most especially manual processes which require the unnecessary installation of collocated facilities -- will introduce an effective barrier to prevent broad-scale local competition from developing.[10]

A. Loss of Service During Cutover

With any form of collocation, there is no escaping the problem that the customer is placed out-of-service for some period of time in order to disconnect and then reconnect network facilities. In the best-case scenario described above, the pre-wiring by the ILEC and CLEC reduces the time that the customer is without service to the time it takes to perform a "hot cut" -- that is, to disconnect both ends of a cross-connect and to reestablish two new cross-connections, without having previously removed the dial tone at the switch.[11]

There is significant room for discretion, however, within the parameters of a "hot cut" to perform the procedure so it has greater or lesser impact on the customer. For example, the ILEC's frame technicians should check in advance of the cutover to make sure that there is no active call on the line. Similarly, the sequence for disconnecting and reconnecting each terminal will affect the amount of time that the customer's service is interrupted. And, because two cross-connections must be made to provision any one customer, the number of technicians that the ILEC uses to provision each order will also affect the amount of customer downtime.

If the assumptions underlying the best-case scenario do not hold, however, then the chances for a prolonged outage increase. Indeed, there are many reasons why the time for a cutover could increase substantially. For example, the best-case scenario assumes that the ILEC is willing to adhere to procedures that require complete pre-wiring to the point that the new cross-connections are tied down on the blocks ready to be cut over (as is typically done with collocation hot-cut arrangements). If any of the pre-wiring is not completed, then

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[10] It should be understood that there are some forms of entry (such as a loop being reconfigured to a different switch) which may require some form of collocation. Where collocation is *needed*, it should be done as efficiently as possible. Where collocation is unnecessary, however, it not only imposes additional costs on the entrant that does not desire collocation, but it also diverts scarce space and resources from those entrants which do. As a result, requiring unnecessary collocation harms *all* competitors by imposing unnecessary costs on some, and diverting important resources from others.

[11] The best-case scenario also assumes that the ILEC would establish methods and procedures to ensure that each hot cut is performed correctly by an experienced crew, so that the amount of time the customer would be kept out of service would be minimized.

the time that the customer will be out of service will significantly increase.[12]

An even longer outage could occur if the pre-wiring is done incorrectly. Examples of predictable errors include misidentified block assignments or cable and pair numbers, defective connections, and "assignments not spare."[13] Given the difficulty of maintaining completely accurate and parallel ILEC/CLEC inventories of all block assignment and frame locations, as well as the numerous points of potential failure on the collocation circuit, there is a substantial chance that such problems would occur.[14] The best-case scenario also assumes that the ILEC will devote the substantial resources -- for instance, overnight shifts of experienced frame technicians -- needed to minimize customer service interruption.[15]

Finally, the best-case scenario assumes that the ILEC will reuse the customer's existing switch port, which is not the announced policy of some ILECs. If an ILEC unilaterally decides to assign a new switch port for every cutover, the process is further complicated because it would then require the precise coordination of two separate work groups who operate at different sites. This policy serves no useful purpose and subjects

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[12] If *no* pre-wiring is done, the out-of-service time will be quite substantial, because at least two individual disconnect/reconnect procedures (two each at the MDF) would need to be completed. Further, if an IDF is involved, the need for two additional procedures at the IDF would further increase customer outage time.

[13] An "assignment not spare" occurs when a technician is given a correct block assignment but discovers on the job that the terminal is occupied by another wire that was mistakenly not removed during a previous job.

[14] Notably, the chances for error are higher than with simple provisioning of unbundled loops, because provisioning the loop/switch combination requires twice as many cross-connections as is required simply to roll a single loop for a CLEC to combine with its own switch (i.e., two cross-connects instead of one, assuming no IDF). To date, however, even in the relatively simpler world of "pure" unbundled loop provisioning (where only one disconnect/new connect need occur in a hot cut), it is clear that CLEC customers have been subjected to substantial service outages. Far from quickly cutting over service in the dead of night, ILECs have frequently left new CLEC customers without service for hours at a time in mid-day.

[15] The need for ILECs to hire and train these technicians should not be underestimated. To handle competitive volumes, it is reasonable to expect that three shifts of technicians would be needed to work around the clock. Today, at many suburban -- and virtually all rural -- central offices, there are no frame technicians on site as a regular matter at any time, because the offices are unmanned. Consequently, to achieve the best-case scenario would likely require a significant increase in ILEC personnel.

CLEC customers to additional outage time and potential for error.

The potential impact of mandatory, unpredictable, and potentially extended service outages on the prospects for local competition cannot be overstated. Customers will be alarmed at the prospect of any service outage, and will not tolerate any prospect of an outage for more than a negligible period of time. Indeed, the service outage necessitated by the manual separation and recombination of network elements would be a severe impediment to a CLEC's ability to compete effectively, because customers will perceive the CLEC is at fault, even though it does not have control over any of the work that the ILEC performs in this process.

B. The Provisioning Limits of Collocation will Gate Market Entry

Quite apart from the customer impact of out-of-service conditions, there are additional competitive obstacles that arise from the limits collocation places on an ILEC's ability to provision loop and switch element combinations. There are four factors which inherently limit collocation:

(1) The time needed to plan and construct collocation cages,

(2) The architecture of the MDF imposes limits on the number of customers that can be provisioned in any given day,

(3) The inability to physically separate IDLC loops, and

(4) The inability to collocate at remote switch sites because of the limited space available at these locations.

The first limit arises from the CLECs' need to establish collocated space -- either physical or virtual -- in every central office that a CLEC wishes to serve using the loop/switch combination. The collocation that CLECs have pursued to date typically involves only a focused group of ILEC central offices in a metropolitan area. If a CLEC intended to use network element combinations to offer business and residential service throughout a state, the demand for collocated space would be much greater.[16]

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[16] In many areas of the country, there are significant limits on the space available for collocation. For instance, Bell Atlantic in New York has indicated that it has space constraints in over half of the central offices where CLECs had requested collocation, and that (as of December, 1997) there was no space at all in 15 central offices. In fact, in 1997 Bell Atlantic -

A second source of market entry delay is the manual work needed to establish the cross-connection on the MDF (and possibly the IDF). As described above, this involves two basic steps that would typically be performed by a team of three technicians: one person working on the line side of the frame, one on the switch side, and a third who coordinates their activity by calling out assignments and block appearances on the frame. This wiring must be done on a customer-by-customer basis, which limits the number of customers that could be provisioned with UNE service in any one day.

Further, in every case where ILEC technicians install new wires on the MDF to accomplish a recombination of the loop and switching elements for an existing customer, the technicians would also have to perform a separate job (or jobs) to disconnect and remove (or "mine") the existing wires from the MDF. Thus, each loop-switch recombination will require at least three (and possibly four) job orders for ILEC technicians at the MDF, which could significantly reduce the number of customers who could actually be moved to a loop-switch combination.

The limits that this manual work places on the number of CLEC customers that can be provisioned on any given day translates directly into restrictions on the CLECs' ability to market their services. CLECs would not be able confidently to engage in mass marketing (for example, radio, television, and print advertisements) because that would likely lead to demand at a given central office far beyond what the ILEC could provision.[17]

The third factor that causes mandatory collocation to gate market entry is the fact that mandatory collocation denies entrants access to IDLC loops. Because individual loops cannot be separated from an IDLC system, mandatory collocation would force customers from this technology if they chose an alternative local provider. Instead, these customers would either be moved to a spare analog copper wire pair or placed on a parallel universal digital loop carrier (UDLC) system.[18] Of course, the analog alternative is only possible

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NY *returned* more collocation applications for lack of space than it processed.

[17] As the FCC has observed in discussing nondiscriminatory access to an ILEC's operations support systems, ILECs must be able to handle "the order volumes and fluctuations reasonably expected in a competitive marketplace," particularly during the early stages of competitive entry when "order volumes" will "be relatively volatile."

[18] UDLC is an older version of digital loop carrier equipment that converts the loops back to an analog service in the central office, thereby allowing an individual customer's line to be accessed at the MDF. This digital-to-analog conversion, however, may degrade the quality of service for the customers involved.

where a spare analog loop meeting the customer's technical requirements can be found in the vicinity of the customer -- a circumstance which may be unlikely in a new development that was provisioned with IDLC from the outset.[19]

Finally, the problems caused by combining the loop and switch network elements only through mandatory collocation are heightened to the extent an ILEC uses remote switch modules. When a remote switch module is employed, the local loop does not terminate at the MDF in the central office, but at a frame located at the remote site (frequently a significant distance from the central office) that houses the host switch. The remote switch module and associated support equipment are typically housed in small spaces. Consequently, collocating equipment for the purpose of recombining loops with these remote switches poses a severe logistical problem due to the lack of space.

C. Mandatory Collocation Results in Degraded Service Quality for Consumers

A mandatory collocation requirement will lead to inherently inferior service quality for CLECs who recombine the unbundled loop and switching elements. The wire used on the MDF is typically 22 gauge, which means that the wires themselves are approximately the diameter of pencil lead. Such thin wires are inherently frail. Moreover, many of the wires connecting loops and switch ports have been in place for many years. One consequence of mandatory collocation is that it requires the unnecessary handling and removal of these wires as customers change local service providers. As significant competition develops and customers begin to churn, the continual activity and increased congestion on the frame caused by installing new cross-connects and removing the old cross-connects will put an unnecessary stress on the frame's jumpers, at times causing a connection to break inadvertently.

The impact of increased strain on the frame and resultant service failures will be borne disproportionately by CLECs, because recombination by collocation will double the number of cross-connections on the MDF frame for CLEC loops compared to ILEC loops. Jumpers in a frame (especially the MDF) are subject to significant pulling and tugging as technicians move other jumpers across or around the frame, or "mine" out old wires that are no longer being used. As this pulling and tugging increases with competitive activity, so too

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[19] In older areas, there may be spare loops if the ILEC has replaced copper loops with IDLC. However, if such loops were abandoned for an upgrade to IDLC technology, it is quite possible that they are of poor quality. Thus, a CLEC customer that is moved from a state-of-the-art IDLC loop onto an old analog loop plant may immediately experience a degradation of service quality.

will CLEC (and ILEC) service failures.

Further, a typical ILEC loop connection in a wire center has only two points of connection to a frame -- one on the terminal connecting to the loop, and the other on the terminal making the connection to the switch port. These points of connection are "points of failure," because they are places where the loop connection is most likely to come apart, as well as points where there is a potential for human error because these connections are established through the manual work of a technician. With mandatory collocation, loops recombined with switching will require an absolute minimum of four points of failure, and could require up to 8 or more such points depending on whether an intermediate frame is used to reach a CLEC's collocation space. Thus, mandatory collocation at least doubles the possibility that CLEC loops will fail or be subjected to the possibility of human error during installation.

The potential for human errors that occur in customer installations will also at least double. In addition to the "ordinary work" (i.e., the work associated with basic loop provisioning) of directing a loop to the correct tie cable corresponding to the CLEC's collocation equipment, technicians must also connect the CLEC's return tie cable to the correct terminals on the MDF block that corresponds to the correct switch port. Thus, technicians will have to perform twice the amount of work for CLEC customers served by the loop/switch combination.

Further, when there is trouble on a circuit, CLECs and the ILEC would have to coordinate efforts to determine whether the source of failure is in the collocated space, the ILEC tie pairs, the jumpers, the MDF, or the software change that made the new switch port assignment. This process will become even more difficult over time, as inevitable errors in recombination work cause incorrect disconnections and incorrect pairings of loops and switch ports.[20]

The additional loop length that would result from mandatory collocation could also require changes in the ILEC's records to reflect the changed characteristics of the loop. If the ILEC does not make these changes, maintenance and repair functions could be impacted. For example, changing the length of loops could have an impact on mechanized loop test (MLT) results, because when the make-up of a loop is changed (that is, the loop in effect becomes longer as it runs to and from the mandatory collocation cage), the MLT could give improper results.

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[20] In contrast, when there is trouble on an ILEC customer's line, no such complicated coordinated effort is required.

Overall, mandatory unnecessary collocation puts unnecessary strain on often already congested frames and on delicate cross-connection wiring, substantially increases the risk of human error and mechanical failure, and complicates central office maintenance and repair procedures. Thus, it could significantly impact a customer's service quality and hamper the CLECs' ability to establish a reputation as reputable providers of local exchange service.

D. Mandatory Collocation Creates Unnecessary Costs

Establishing physical collocation arrangements not only adds substantial delay and potential for service degradation, it also creates unnecessary (and potentially huge) costs for CLECs. There are six major cost components that a CLEC would incur if forced to use physical collocation to combine unbundled network elements:

(1) Non-recurring charges for the collocation application, site preparation and cage construction;

(2) Non-recurring charges for connectivity;

(3) Non-recurring charges for installing cross-connections necessary to migrate customers;

(4) The non-recurring cost of CLEC equipment purchase and installation;

(5) Recurring charges for space rental; and

(6) Recurring charges for connectivity.

These costs can be staggering for a new entrant that must use collocation solely for the purpose of combining ILEC elements. The cost categories of a virtual collocation arrangement are not significantly different. The major costs of collocation are those needed to establish and maintain connectivity between the ILEC's MDF and the CLEC's collocated facilities, and to move individual loops from the ILEC's MDF to the collocated space. These costs do not typically vary between a physical and virtual arrangement. Although a CLEC using virtual collocation would not face the costs of building a collocation cage, it still will have initiation costs for the virtual arrangement, which include the costs of the space preparation and equipment installation as well as the costs of purchasing the collocated equipment. In addition, the CLEC will have ongoing costs for space and for remotely monitoring its equipment and obtaining maintenance from the ILEC.

All of these costs are in addition to "ordinary" service-order charges that a CLEC would typically pay an ILEC to obtain network elements. Significantly, none of these charges enable CLECs to provide customers with a single additional functionality. In fact, as described above, these additional steps and facilities come at the cost of increased customer outage, lower service quality, and significant gating of competition.

V. Conclusion

Proposals calling for mandatory and unnecessary collocation arrangements for the combination of network elements are inherently discriminatory and create substantial barriers to competition. All collocation proposals suffer from the same infirmity -- an extensive reliance on manual processes and repetitive cross-connections to combine elements circuitously that are connected directly in ILEC networks. Collocation does not satisfy the ILEC's legal obligation to provide entrants non-discriminatory access to combine network elements.

B

Using Recent Change to Combine Network Elements

I. The Operation of Recent Change Software

"Recent change" is an industry term used to describe the capability of a switch that allows a LEC to update the office specific software of its switch. ILECs use the recent change capability, among other things, to establish the electronic connections that combine the functionality of the loop with the functionality of the switch, so that a customer can originate or terminate telephone service.

In order to describe how the recent change software works, it is important to understand the two different kinds of software systems that ILECs employ in their local switches. "Generic" software is provided by the switch vendor and used to perform functions that instruct the switch how to process and record calls. Such software is developed and maintained directly by the switch vendors, not the LEC. Updates to the generic software come from the vendor at infrequent intervals, generally no more than once a year.

In contrast, "office specific" software permits identical switches from a single vendor to differ from each other. The switch vendor initially supplies this software, but the software is designed so that it can be maintained and updated by the LEC itself. Office specific software enables the LEC to define switch specific items, such as what NXX codes the switch serves, where traffic originating or terminating at the switch should be routed, and the feature capabilities, telephone number and blocking that is assigned to each customer line. Most important for these purposes, this software also allows the LEC to initiate or discontinue service on specific customer lines. On a typical business day, a LEC makes large numbers (hundreds or even thousands) of recent change updates to its office specific software for each switch.

The recent change process is generally triggered off of an ILEC's ordering and provisioning systems. When a ILEC customer service agent takes an order and enters it into its ordering systems, the customer specific data flows from the ordering systems, through the ILEC's provisioning systems and updates the switch software on the due date of the order. For example, if a customer wants to add a new feature such as call waiting, the ILEC service agent takes the order, establishes an installation date with the customer (often that day), and sends the order into the ILEC ordering systems. At the designated time, the ILEC's provisioning systems send a recent change message to the switch that enables the customer's line to use the newly ordered feature.

The recent change process is also used to make other changes to a customer's line, such as the change of a primary intraLATA toll carrier or interexchange carrier. This activity alone accounts for tens of millions of recent changes implemented by ILECs annually. In 1997, customers changed their long distance carrier 53 million times.[1] Each of these changes were provisioned through the ILEC's recent change systems -- none required any physical work inside or outside the central office.

Another example of ILEC's use of the recent change capability -- and the one most relevant to evaluating the access given an entrant to combine network elements -- is when existing ILEC customers request to have service discontinued because, for example, they are moving. Upon receiving a disconnection request from the customer, the ILEC customer service agent enters keystrokes that generate an order in the ILEC ordering systems. The ILEC ordering systems then trigger the ILEC provisioning systems to send a recent change message to the switch on the date the customer requests. When the recent change is implemented, the ILEC switch electronically disconnects the loop from the functionality of the switch through a process which is entirely automated. Once the agent enters the customer's service request, the information automatically flows through the ILEC's systems, and no manual work is necessary to disconnect the customer's service.[2]

Similarly, when a new customer moves into the location vacated by the first customer, an ILEC uses the recent change process to reconnect the functionality of the loop and switch. Again, the agent takes an order from the customer and enters keystrokes into a terminal. The service request then passes through the ILEC's ordering systems, which send a message to the ILEC's provisioning systems to send an appropriate recent change message to the switch at the requested service start date. At that time, the ILEC's provisioning systems direct the switch to reconnect the functionality of the loop and switch, thus provisioning the customer's service. As with the disconnect order, this process is fully

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[1] Affidavit of Glenn Hubbard and William Lehr, California Public Service Commission, Docket R.93-04-003, et. al., paragraph 47.

[2] Some ILECs have indicated that they do not always use recent change in these circumstances, in order to keep facilities in use where they are needed. This is a sound engineering practice in those few central offices with limited spare capacity relative to demand. In these offices, rather than have the vacated switch port remain idle waiting for a new customer to arrive, it is immediately reused to provide service to a customer who may have been on a "held order" because of a lack of spare facilities in the central office. However, this circumstance has no relevance at all in cases where a CLEC wants to obtain a combination of elements from the ILEC, because the ILEC's facilities will be *immediately* used by the CLEC to provide its own service.

automated, and no ILEC network technician touches any wires anywhere in its network.

When an ILEC disconnects a loop from the switch using the recent change process, these two elements no longer function in combination with each other. The recent change prevents the switch from recognizing an off-hook condition on that loop. The switch does not provide dial tone on the line and blocks all of the call processing capabilities of the switch from being accessed by the line (for example, it does not recognize any digits or pulses dialed from equipment connected to the line). In addition, the recent change prevents the switch from terminating any calls to that line.

The point is that the use of recent change can achieve exactly the same result as if the ILEC's technician had removed wires on the customer's loop from the MDF, breaking the physical link between the loop and the switch. As SBC's witness recently testified in Texas, after an ILEC has disconnected a loop from the switch using recent change, when callers take the phone off the hook "[t]hey get nothing."[3]

Incumbent LECs also use the recent change process to combine other elements. For example, if an incumbent LEC decides to relieve an over-burdened tandem switch that serves end office switch A and end office switch B, physically installing new transport between those switches is not sufficient to accomplish the task. To effect a functioning connection between the new transport facilities and these switches, each switch's recent change memory must be reprogrammed to connect -- and thereby route traffic -- over the new transport elements.

The ILECs use recent change because it is the most efficient use of their resources. Sound practice is to make as few manual (i.e., physical) changes to its network as possible. Manual processes take longer to perform, cost more money to implement, and are susceptible to higher error rates than processes that are implemented through software-based tools. The software-driven networks of the present (and future) rely on recent change to effect those routine tasks necessary in a day-to-day environment.

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[3] Hearings Transcript, TR 809-810, Public Utility Commission of Texas, Case No. 16251, April 22, 1998.

II. The Application Of The Recent Change Process To Enable CLECs To Combine Unbundled Network Elements

A. Overview

As explained above, the recent change process is a important component in the ILEC's network management. Just as the ILEC uses the recent change process to manage the network elements its uses to provide services, in several key circumstances recent change can similarly be used by CLECs to combine and manage network elements obtained from the ILEC.

In abbreviated form, CLECs could use the recent change process to combine the local loop and local switching network elements as follows:[4]

1) The CLEC receives a service request from a customer wishing to change carriers.

2) The CLEC service agent issues a service order to the ILEC for the network elements needed to serve this customer.

3) As part of the processing of the CLEC order, the ILEC prepares a "disconnect" order that will electronically uncombine the loop and switch port serving the customer at the appointed time.

4) After the CLEC receives a firm order confirmation from the ILEC, the CLEC provisioning system initiates a recent change that will be held in the buffer of the firewall and, at the appropriate time, will electronically reconnect the loop and switch elements.

5) On the due date of the order, the ILEC's systems issue the disconnect order on the customer's line. This order is matched to the CLEC's reconnect order that is held in the firewall's buffer. The electronic disconnect recent change order will instruct the switch to remove the functionality of the loop from the switch and, immediately following this activity, the CLEC's reconnect recent change order will

[4] The local switching network element also provides access to the other network elements necessary to provide exchange services, such as signalling, operator and directory systems and shared transport.

recombine the functionality of the loop with the functionality of the switch for the CLEC's customer.

6) When the ILEC system completes its disconnect command, the switch would notify the system that the disconnect order was performed. Assuming the CLEC correctly issued a reconnect command, the system would initiate the associated CLEC recent change request from the buffer. Such activities could be completed within a matter of seconds and be performed automatically during off-peak hours, to minimize customer outage.

CLECs can use the recent change process to combine both existing and new loops with unbundled switching. When a CLEC wants to combine the functions of a new (i.e., not previously existing) ILEC loop and switching, it is important to note that at least two separate work activities are necessary before service can be provided on the new line. Clearly, some physical work must be done. Generally, this work occurs both outside the central office to connect a spare loop facility to the customer's premises, and within the central office to connect the loop to a spare switch port. However, the physical work by itself does <u>not</u> make the customer's line functional.

A second, separate activity is just as essential to create the customer's new serving arrangement: combining the functionality of the switch with the customer's new loop. This is accomplished by performing a recent change on the switch software to assign the line a telephone number, to implement any features or screening the customer requested, and to provide the customer dial tone for outgoing calls. Indeed, it is the implementation of the recent change process, rather than any mere physical connection, which gives the customer's line any functionality and establishes service for the customer. Without the latter, the customer's line is as useless as if the physical links were never installed.

B. Systems Used to Provide Access to Recent Change Capabilities

The recent change process is implement through specific OSS provisioning systems. These provisioning systems are separate from the ILEC's ordering systems and are the software-based tools that the ILEC uses to implement service orders, both for its own retail customers and for CLECs.

Significantly, even today the capabilities of these provisioning systems are not accessed solely by the ILEC. ILECs also allow large business customers who purchase Centrex services to perform recent changes on its switches. Among other things, these customers are permitted to issue software-based instructions that can: disable a line, enable a line, add or remove features from a line, move a line within the customer's location and apply screening codes that prevent certain types of calls (e.g. 900, international) from being dialed.

The ILECs generally use two different OSS systems that permit Centrex customers to access the recent change process. COMMTECH Corporation manufactures one, called MACSTAR, and Bellcore manufactures the other, which is called CCRS. These systems have the capability to operate with all types of switches in the ILEC's network. The fact that this capability is available and used today by the ILEC's Centrex customers demonstrates that it is technically feasible to make the capability available to entities other than the ILEC, without any threat of network security or harm.

Centrex customers access the recent change capabilities of the switch through an OSS that serves as a "firewall" between the Centrex user and the ILEC's switches. The provisioning OSS that the Centrex customers use is partitioned for each user. Within the partition, the OSS is populated with the contiguous block of codes (phone numbers) that have been assigned to the specific Centrex user. The OSS allows the Centrex user to perform specific types of recent changes only on the lines that are subscribed by that customer. Because individual Centrex customers can only access the switch to make authorized types of changes for lines that are assigned to them, they cannot perform a recent change that would impact any other customer on the switch.

In the ILEC's network the MACSTAR system is directly connected to the switches the system serves. Centrex customers access MACSTAR either through a dial-up arrangement or a dedicated line to initiate a recent change on their line(s). Once MACSTAR recognizes that the customer is authorized to perform the requested activity on the affected line(s), it interfaces directly with the ILEC switch to effect the recent change.

The practical implication of these customer-accessed provisioning systems to the recent change capability of the switch proves that it is technically feasible to create systems that access the ILEC's recent change process without creating any risk to network security or reliability.

C. The Development of CLEC-Access Systems to Recent Change is Both Practical and Feasible

It is both practical and feasible to create a means for CLECs to access the ILEC's recent change process. As explained above, even after a loop is physically attached to a switch, the ILECs use the recent change to combine the functionality of these two network facilities. Similarly, if CLECs are given nondiscriminatory access to the recent change process in the same way that the ILEC and its Centrex customers are, they can perform these recent changes themselves and combine the local loop and local switching network elements so that service may be provided to end users.

To provide CLECs access to the recent change capabilities of the local switch will require investment and OSS development by both the CLECs and ILECs. As explained above, ILEC systems will need to be implemented which establish "firewalls" similar to those which exist in the Centrex environment today.

From the CLEC's perspective, however, new provisioning systems will be needed to effect recent change commands that are very different from the OSS systems that CLECs need to place service requests, to obtain information from the ILEC, and which interface with the ILEC's pre-ordering and ordering OSSs. To use recent change requires that the CLEC obtain a separate provisioning capability that will interact directly with the firewall interface to the ILEC's own recent change administration systems. Unlike any other OSS, access to this system will enable the CLEC to give direct commands that can be passed (via the ILEC interface and provisioning system) into the switch.

The CLEC's OSS interface will have to be properly programmed, again at the CLEC's expense, to send the correct instructions to the ILEC interface. If the CLEC fails to do so, or if in any particular case a CLEC service representative forgets to issue the proper commands or issues incorrect ones, the CLEC customer will not receive service as requested.

Using this process, the CLEC would inform the ILEC, through its service order, that the ILEC should initiate a disconnect recent change command for the customer involved, which would electronically separate the functionalities of the previously combined loop and port.[5] The CLEC would separately initiate a "reconnect" recent change provisioning command to recombine the functionality of the loop and the switch. These two functions would be coordinated by having the CLEC's electronic reconnect activity held in a buffer until the ILEC's disconnect order is sent. At that time, the CLEC provisioning command would be associated with the ILEC disconnect command, so that both can be processed with the minimum amount of customer disruption. In addition, to avoid customer impact, as well

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[5] As discussed in detail in the body of this white paper, CompTel does not believe there is any rational justification to separate network elements solely for the purpose of forcing the entrant (and ultimately, the entrant's customers) to incur the cost (and customer outage) involved with recombination.

as any possibility of congestion in the switch, these commands should all be programmed to operate in the early morning hours.

The same process could be used to combine the functionality of the switch with the functionality of a new loop that has not previously been in service. As described above, even though a loop and port are physically connected, they are not combined in a functional sense until the switch software is updated through the use of a recent change message. In this situation, the ILEC would perform the work necessary to physically connect the loop and port. This activity would likely also involve work that is performed outside the central office, such as making a connection at a feeder distribution interface, and cross-connect work performed within the central office.[6] After the physical work is completed, the CLEC can, on the service due date, direct the switch to perform the recent change to electronically combine the loop with the port.[7]

The development work necessary to create a software tool that CLECs can use to combine loops and switching is relatively straightforward and should not be especially time consuming or costly. Although systems are not yet available, COMMTECH (the developers of software used to provide Centrex customers access to recent change) has indicated that the necessary development could be completed, tested and ready for deployment within six months -- assuming that the ILECs provide the necessary information and cooperation.

D. Estimated Cost to Provide CLEC Access to Recent Change

The OSS firewall needed for CLECs in the recent change context is similar to the one that is available today for Centrex customers. The main changes necessary are: (1) to limit CLECs' access to the specific line numbers of their customers, rather than the blocks of numbers assigned to Centrex customers and (2) to allow the system to coordinate the disconnect and reconnect recent changes sent by the ILEC and CLEC, respectively, to minimize the outage impact on the customer.

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[6] Establishing the initial physical connection between a loop and switch port is no different than other non-recurring installation activities, such as connecting a loop to a NID or feeder systems. And, in fact, with modern IDLC technology, the loop/switch connection is an integral part of the loop itself.

[7] In contrast to the case of a preexisting service, there is no need for the ILEC to send a disconnect order for the customer's new line, because the elements were not previously electronically combined to enable the ILEC to provide a service over that line.

The first change can be made through the development of a database table that is updated via the ILEC's provisioning process and identifies each of the telephone numbers or lines for which a specific CLEC may send modifications through the ILEC firewall interface into the recent change process of the switch. Table-driven databases are a standard type of development project that require no special background in telephony. Moreover, because the CLEC's use of the recent change for a particular customer will not occur until after the ILEC sends its disconnect message, there will be sufficient time for the ILEC to populate the database with information regarding the identification code of the new carrier chosen by the customer.

Establishment of the coordination between the ILEC and CLEC provisioning commands requires only the establishment of a buffer that holds the CLEC's recent change until the ILEC sends its own message to the switch software. This is also a simple development project.

The preliminary estimate of the right-to-use fee from COMMTECH is $3 million per RBOC. Based on current input regarding system requirements, it appears that no other systems development will be required on any of the ILEC legacy OSSs. The equipment platform for this system uses existing technology (HP 9000K series hardware), which would cost approximately $250,000 per unit, and no more than two units (with one serving as a back-up) would be needed to serve an entire state.[8]

III. Advantages of the Recent Change Process

Recent change is significantly better for CLECs and consumers than any of the collocation-based methods suggested by the ILEC for the following reasons:

(a) Recent change does not entail the substantial delay required to establish a collocation arrangement in each and every ILEC central office for the sole purpose of combining loops and ports;

(b) Recent change, if developed and implemented properly, substantially reduces the customer outage associated with collocation;

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[8] These costs are particularly modest when compared with the enormous expense of implementing the ILEC collocation proposals. See Appendix A for a description of these proposals.